

# Modern Engineering

Day 1

## Prudential Financial



# Whilst we wait....

In chat write:

Your name, role, and a recent impulse buy.

Let's give  
everyone a min  
or two to join



# Meet General Assembly Your Instructor



## Ben Piper

**Author and Consultant, Coastal Carolina Networks**

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- Ben Piper is the author of several Sybex study guides, including the *AWS Certified Solutions Architect Study Guide*, *AWS Certified Cloud Practitioner Study Guide*, *CompTIA Cloud+ Study Guide*, and *CCNP Enterprise Certification Study Guide*. He has also created 40+ Pluralsight courses covering AWS, networking, and configuration management, and wrote *Learn Cisco Network Administration in a Month of Lunches* [Manning].
- Prior to this, he has had a diverse career spanning retail, finance, and healthcare industries, where he performed network, Linux, Windows, Citrix, and VMware administration.

Meet General Assembly

# Your Instructional Associate



**Troy Swayzee**  
**Software Engineer**

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- Troy has supported Consumer learners as Lead Instructor for General Assembly's Software Engineering Immersive programs since 2021.
- He spent over 3 years as a Software Engineer at Archbright engineering BI/IT integrations, applications, infrastructure and tools that enhanced the company's operations and services.

Meet General Assembly

# Your Instructional Associate



## Mario Recinos

GA Instructor and Software Engineer

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- Mario is a dedicated Software Engineer and passionate educator, committed to empowering underserved communities with technology resources.
- He is a proud graduate of General Assembly SEI, 2021 before joining General Assembly Instructional Associate for six cohorts over the past two years.
- Previously, Mario garnered valuable professional experiences as a Software Engineer and Ambassador for Y-Combinator startup. He mentored individuals from non-traditional backgrounds guiding them to break into the tech industry to actively strive to bridge the technology divide for underserved communities.



# Remember Your To Do List

- Be engaged and ask questions  
Start every session with your microphone **muted** and **camera on**
- Communicate with us
- Don't be afraid of breaking things
- Don't worry about writing things down
- Try not to get distracted by your inbox or phone calls
- Help your peers out



You will receive digital copies of the slides in your inbox after today.

# Our Goal

The goal of this seminar is to introduce approaches, architectures, and patterns to add to your toolbox.

It is up to you to decide **HOW** to use these tools.

**There are no absolute rights and wrongs.**



# Need to Know?



**You don't need** to know and understand every legacy or modern IT system, application, network protocol, database technology, or programming language. Even experts in a very specific field don't know everything about every aspect of their specialism.



**You do need** to grasp the core concepts and terminology and be able to identify some of the hallmarks of legacy and more modern architectures.



Any Questions

# PROGRAM OVERVIEW | Modern Engineering Fundamentals

 Instructor-Led

 Live Online

 ~ 160 Hours

 ~ 4 Weeks

## Overview:

The purpose of this course is to prepare participants to be comfortable working in more modern architecture paradigms, **whilst developing the skills to enable them build a production ready secure API using modern tools and practices**

### Prior To Course

**3 Weeks Prior:** Assessments and Pre Learning

**1 Week Prior:** 1 hour virtual installfest and pre-install instructional doc

Kickoff

Review

MODULE 1 : Architecture & Requirements	MODULE 2 : Building the API	MODULE 3 : Building the Front End	MODULE 4 : Test-Driven Development	MODULE 5 : CI/CD, Docker & AWS
2 Days	3-4 Days	3-4 Days	3-5 Days	3-5 Days
Legacy Systems & The Cloud	One Datastore per Microservice	Introduction to React	Test Driven Development	Review React App
Cloud Architectural Models	Relational vs. Non-Relational	React Components	Beyond TDD	Docker & Containerization
Microservices	Choosing Your Database	React Props	Mocks, Stubs, Fakes	CI/CD
Web Application Security	Schema Management	React Hooks	Introduction to Jest	CI/CD with Jenkins - Demo
Encryption at Rest	Saga	React Styling Approaches	Introduction to Selenium	Introduction to Cloud Formation
Encrypted Active Data	Introducing Axios: JavaScript	React Routing	Testing a Function and API's	Criticality of GOOD Logging
Authorization, Roles Permissions	Request Library	Axios	Design Unit Tests	3-4 Days
Configuration & Secrets	Build APIs From Scratch	Build missing Model Application UI	Build the Unit Tests	Case Study
Exploring the Model Application API with Postman				*Capstone Development
				*Capstone Presentations

# Week 1 Class Schedule: APIs and Databases in JavaScript

	Day 1	Day 2	Day 3	Day 4	Day 5		
9:00 AM	Legacy Systems & the Cloud	Testing APIs with Postman	SQL			JSON Web Tokens	
10:00 AM	Web Application Security	Postman Application	Build Raw SQL Queries	APIs with Express To-Do List		Lab - Complete Gold Codes	Lesson - Instruction
11:00 AM			Lunch				Instructor-Led Lecture, Guided Walk Through, and Modelling
12:30 PM							
1:30 PM	Microservices	SQL Intro			Related Models	Practice - Application	Solo Work Pair Activity Group Activity
2:00 PM			Lab - SQL queries with Carmen Sandiego	Lab - Solo API	Users + Todos		
3:00 PM	Full Environment Set-Up	Superstore Exploration					
4:00 PM							
5:00 PM	Review	Review	Review	Review	Review		



# Week 2 Class Schedule: React, Intro to TDD

	Day 6	Day 7	Day 8	Day 9	Day 10		
9:00 AM	Introducing React	React State and Hooks	React Unidirectional Data Flow	Full Stack React	TDD in JavaScript	Lesson - Instruction	Instructor-Led Lecture, Guided Walk Through, and Modelling
10:00 AM							
11:00 AM	React Hello World	Lab - Weather API	Fruits Filter Code Along	Lab - ToDos App	Lab - Unit Tests with Jest		
12:30 PM	Lunch						
1:30 PM	Components and Props	Styling in React	React Router		API Testing with SuperTest	Practice - Application	Solo Work Pair Activity Group Activity
2:00 PM				Solo Full-Stack App			
3:00 PM	Lab - Passing Data Around	Lab - Add Material UI to components	Routing Lab		Lab - API Tests		
4:00 PM							
5:00 PM	Review	Review	Review	Review	Review		



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10:00 AM	React Hello World	Lab - Weather API	Lab - Add Material UI to components	Routing Lab	Solo Full-Stack App Continued		
11:00 AM							
12:30 PM	Lunch						
1:30 PM	Components and Props	Intro to Fetch	React Unidirectional Data Flow	Full Stack React	TDD in Javascript	Practice - Application	Solo Work Pair Activity Group Activity
2:00 PM	Lab - Passing Data Around	Lab - Weather API	Fruits Filter Code Along	Lab - ToDos App	Lab - Unit Tests with Jest		
3:00 PM							
4:00 PM							
5:00 PM	Review	Review	Review	Review	Review		



# Week 3 Class Schedule: TDD, Containers

	Day 11	Day 12	Day 13	Day 14	Day 15		
9:00 AM	Load Testing, Mocks, Stubs, Fakes	Selenium Testing	Docker and Containerization	Jenkins CI/CD Pipelines	AWS Cloud Formation Template Guest Demo	Lesson - Instruction	Instructor-Led Lecture, Guided Walk Through, and Modelling
10:00 AM							
11:00 AM	Pair Programming TDD Escape Room	Lab - Selenium Tests	Lab - Containerize ToDo List API	Lab - ToDo Pipeline			
12:30 PM			Lunch				
1:30 PM	UI Testing with Jest			AWS DynamoDB NoSQL vs SQL research discussion		Practice - Application	Solo Work Pair Activity Group Activity
2:00 PM		Create Selenium and Unit Tests for a previous App	Dockerize an Application		Deployment to Prudential AWS Guest Demo		
3:00 PM	Lab - Tests with React and Jest			Lab - Replace SQL with Dynamo in an API			
4:00 PM							
5:00 PM	Review	Review	Review	Review	Review		
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# Week 3 Class Schedule: TDD, Containers

	Day 11	Day 12	Day 13	Day 14	Day 15		
9:00 AM							
10:00 AM	API Testing With Supertest	UI Testing with Jest	Docker and Containerization	Jenkins CI/CD Pipelines	AWS Cloud Formation Template Guest Demo	Lesson - Instruction	Instructor-Led Lecture, Guided Walk Through, and Modelling
11:00 AM	Lab - API Testing	Lab - Tests with React and Jest	Lab - Containerize ToDo List API	Lab - ToDo Pipeline			
12:30 PM			Lunch				
1:30 PM	Load Testing, Mocks, Stubs, Fakes	Selenium Testing		AWS DynamoDB NoSQL vs SQL research discussion		Practice - Application	Solo Work Pair Activity Group Activity
2:00 PM		Lab - Selenium Tests + Create Selenium and Unit Tests for a previous App	Dockerize an Application		Deployment to Prudential AWS Guest Demo		
3:00 PM	Pair Programming TDD Escape Room			Lab - Replace SQL with Dynamo in an API			
4:00 PM							
5:00 PM	Review	Review	Review	Review	Review		
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# Week 4 Class Schedule: Case Study and Capstone

	Day 16	Day 17	Day 18	Day 19	Day 20		
9:00 AM							
10:00 AM	Full Review Code-Along	Capstone Project	Capstone Project	Capstone Project	Capstone Project	Lesson - Instruction	Instructor-Led Lecture, Guided Walk Through, and Modelling
11:00 AM							
12:30 PM	<b>Lunch</b>						
1:30 PM						Practice - Application	Solo Work Pair Activity Group Activity
2:00 PM							
3:00 PM	Full Review Code-Along	Capstone Project	Capstone Project	Capstone Project	Capstone Review		
4:00 PM							
5:00 PM	Review	Review	Review	Review	Review		



## CLOUD COMPUTING ESSENTIALS

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# LESSON ROADMAP



Discover Cloud  
Computing

Moving to the  
Cloud

Traditional to  
Modern  
Applications

Microservices

Virtual Machine  
Set-Up

Bring It Home

# MEF MODULE 1 DAY 1: Architecture & Requirements

Schedule	
9:00–9:15 am	Welcome and Warm-Up
9:15–10:30 am	<b>Legacy Systems and the Cloud</b>
10:30 am–11:15 pm	<b>Web Application Security</b>
11:15–12:30 pm	<b>The Model Application</b>
12:30–1:30 pm	Lunch
1:30-3:00 pm	<b>Environment Set Up</b>
3:00–4:00 pm	<b>Code Exploration of the DMV App</b>
4:00 - 4:50 pm	API Design Considerations
4:50–5:00 pm	Bring It Home



# LEARNING OBJECTIVES

1

Articulate the benefits and drawbacks of moving to the cloud.

2

Identify major concepts involved with cloud computing.

3

Leverage the best concepts and practices for modern cloud applications.

4

Remove doubts, fears, and reservations associated with cloud computing.



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# Legacy Systems & The Cloud



# Hallmarks of Legacy Architecture

## Application Silos

- Apps that were never designed to interoperate remain inflexible “black boxes”

## Monolithic Architecture

- Can lead to slow release cycles and more complex deployments

## Decentralised Data

- Inaccessible between departments
- Could be stored in anything from excel spreadsheets to untamed databases

## Inefficient Data Processes

- Including time consuming backups to physical media on site or off

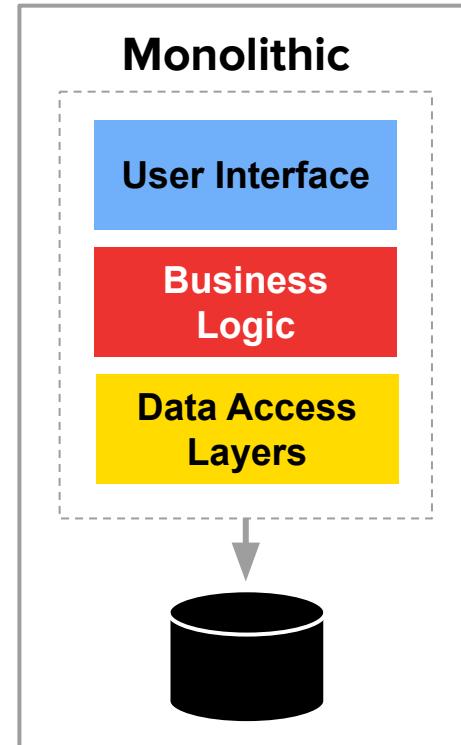


Image 1: Hallmarks of Monolithic Architecture Diagram

# Benefits of Legacy Systems

## Durable.

- A legacy system can be notoriously durable, supporting essential business processes throughout a lifetime.
- This makes them virtually indispensable for many companies.



## Gives customers what they're used to.

- This may be a primary concern for many service-based enterprises.
- Giving customers a consistent experience, without major changes over the years, is a big advantage.

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# Cloud Architectural Models



# The Monolith

The application is a single self-contained unit and does not rely much on other applications.

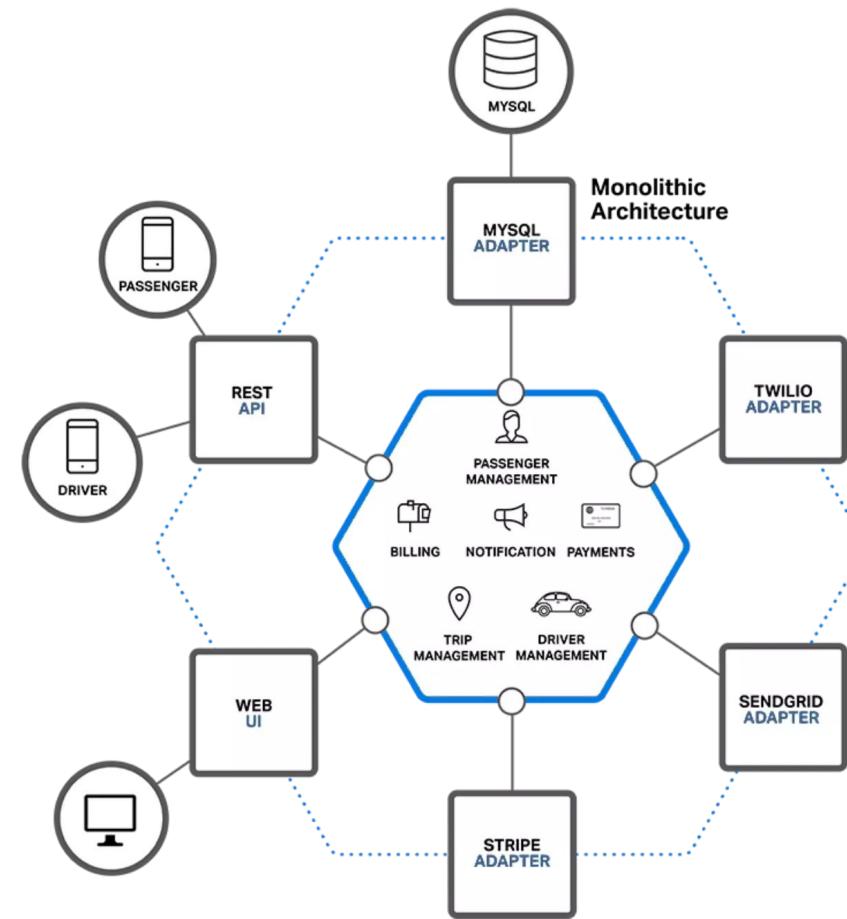


Image 2: Monolithic Architecture Diagram

# The Good

- A single codebase to manage
- Easier to cross-share information
- Centralized control of all data
- Simpler deployment
- Easier end-to-end testing
- Performance

# The Bad

- Harder to scale
- Single point of failure
- Change has more risk
- Slow development speed at scale
- Reliability
- Lack of flexibility
- Higher risk to deployment

# Monoliths are **NOT** a bad thing!

There are many circumstances where they are more reliable and easier to maintain than other patterns.



# The Service-Oriented Architecture

- A transitional design between a classic monolith and micro-services.
- Actions are broken out into discrete services.
- A common database may be used and one deployment may house multiple services.

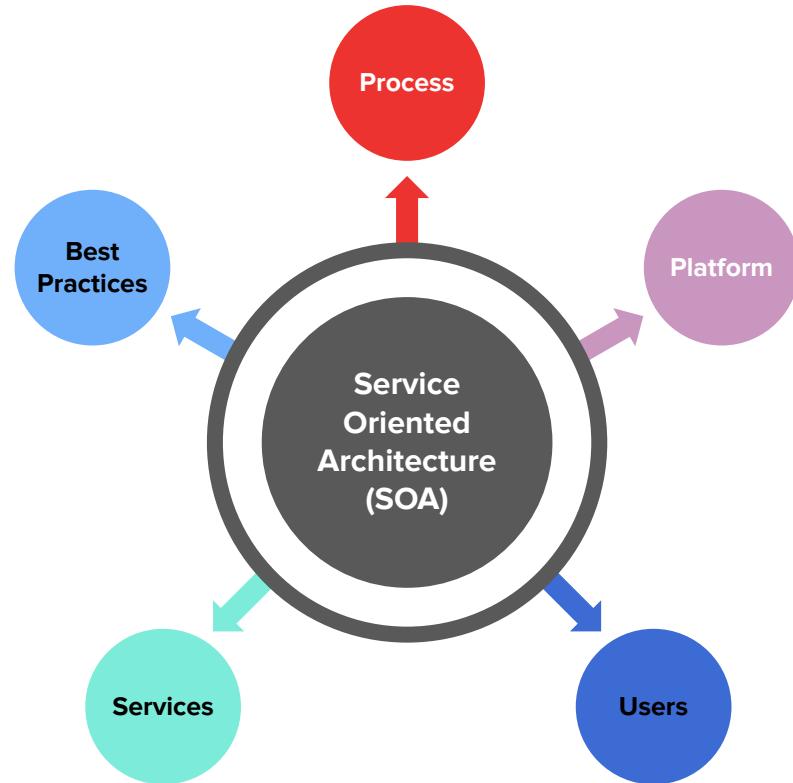


Image 3: The Service-Oriented Architecture Diagram

# Service-Oriented Architecture



## The Good

- Somewhat simpler codebase to manage
- Stronger separation between display and logic
- Easier to replace components in the future
- Easier to cross-share information
- Centralized control of all data
- Performance

## The Bad

- Services can still be complex
- Common data stores create cross-dependencies
- Will eventually evolve into a monolith-like codebase

# SOME MAJOR BENEFITS

## Reliability

Cloud services are built from the ground up to be fault tolerant and are spread across multiple physical locations.

## Speed

Computing resources can be provisioned in minutes with just a few clicks.

## Productivity

Teams are able to bypass hardware setup, software patching and other time-consuming IT chores to focus on delivering value and solving business problems.

## Security

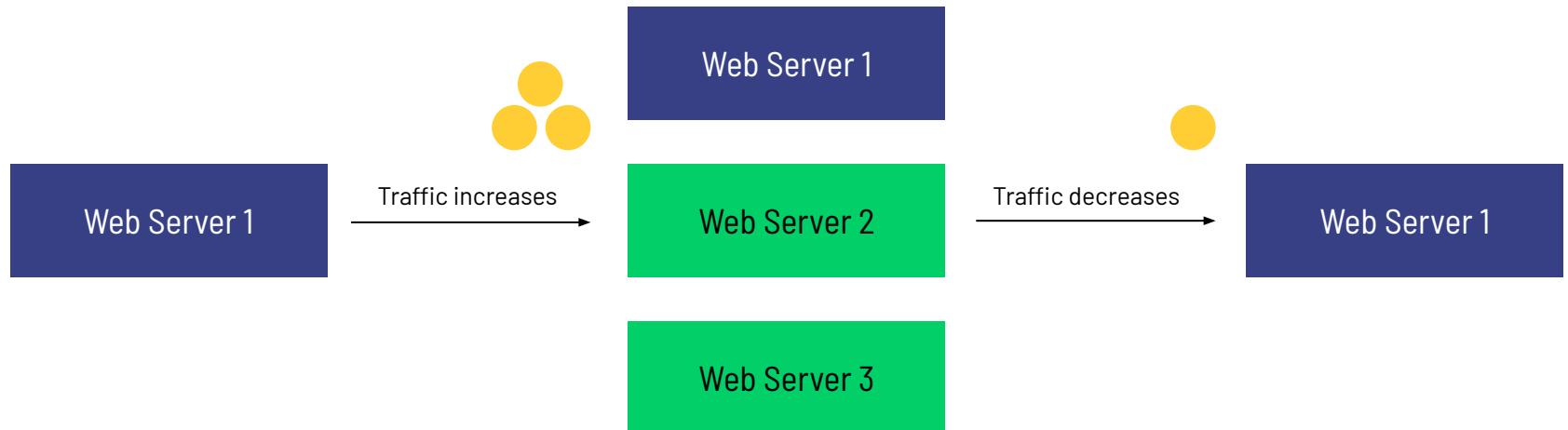
Automatically leverage the expertise and resources of large tech organizations in regards to securing infrastructure.

## Cost Savings

Cloud computing eliminates the capital expense of buying hardware / software and maintaining it.



# SCALABILITY

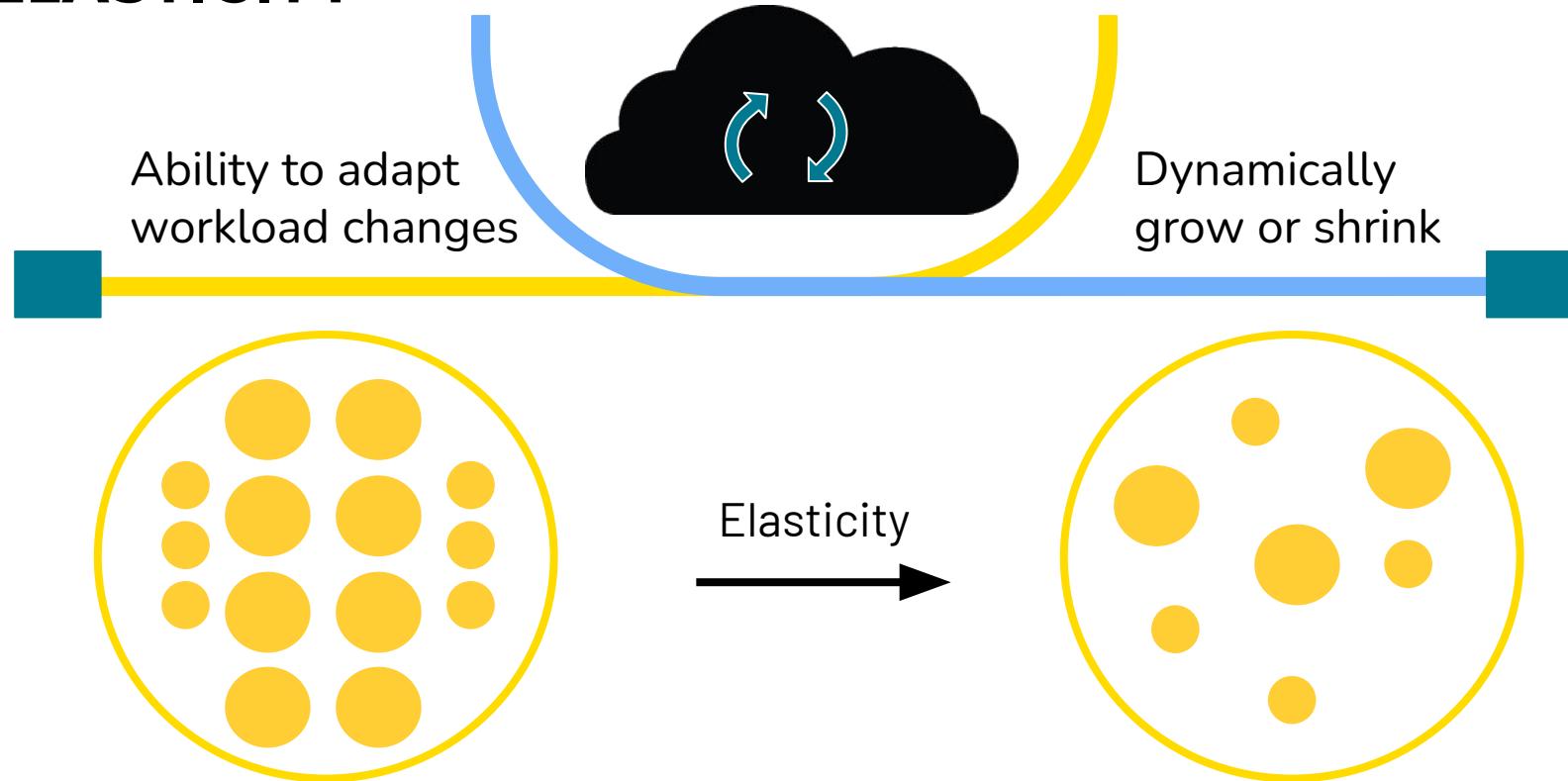


**With a capex model (owning the hardware onsite) it was a question of putting your finger in the air to anticipate shifting storage requirements. Now we can see what we need immediately and accommodate changes very easily in the most cost-effective manner.**

Paul Brown, IT Director for Infrastructure & Support, [Cordant Group](#)



# ELASTICITY



# Elasticity: Who Needs It?

What kinds of business might benefit from elasticity?

Come off  
mute or  
raise your  
hand to  
share your  
answers.

**By switching to the AWS Cloud, our uptimes went from around 95 percent to 99.999 percent. We no longer run the risk of downtime impacting revenues.**

Jinwei Lin, Assistant Manager, SETTour



# THE THREE MODELS

**Software as a Service  
(SaaS)**

**Infrastructure as a Service  
(IaaS)**

**Platform as a Service  
(PaaS)**



# INFRASTRUCTURE AS A SERVICE

IaaS provides the same technologies and capabilities as a traditional data center without having to physically maintain or manage all of it.

Examples include:

- Amazon Web Services (AWS)
- Digital Ocean
- Google Compute Engine (GCE)
- Microsoft Azure
- Linode

**Applications**

**Data**

**Runtime**

**Middleware**

**Operating System**

**Virtualization**

**Servers**

**Storage**

**Networking**

You Manage

They Manage



# SOFTWARE AS A SERVICE

SaaS is a cloud-based service where instead of downloading software onto your computer to run, you instead access an application via an internet browser.

Examples include:

- Gmail
- Dropbox
- Salesforce
- Confluence

Applications

Data

Runtime

Middleware

Operating System

Virtualization

Servers

Storage

Networking

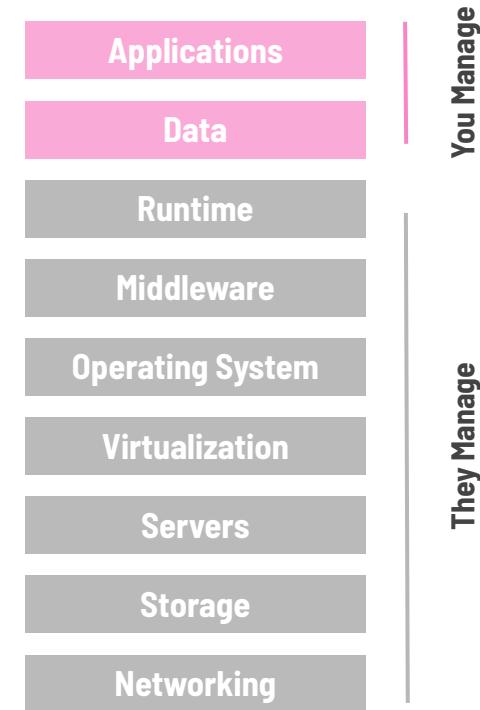
They Manage

# PLATFORM AS A SERVICE

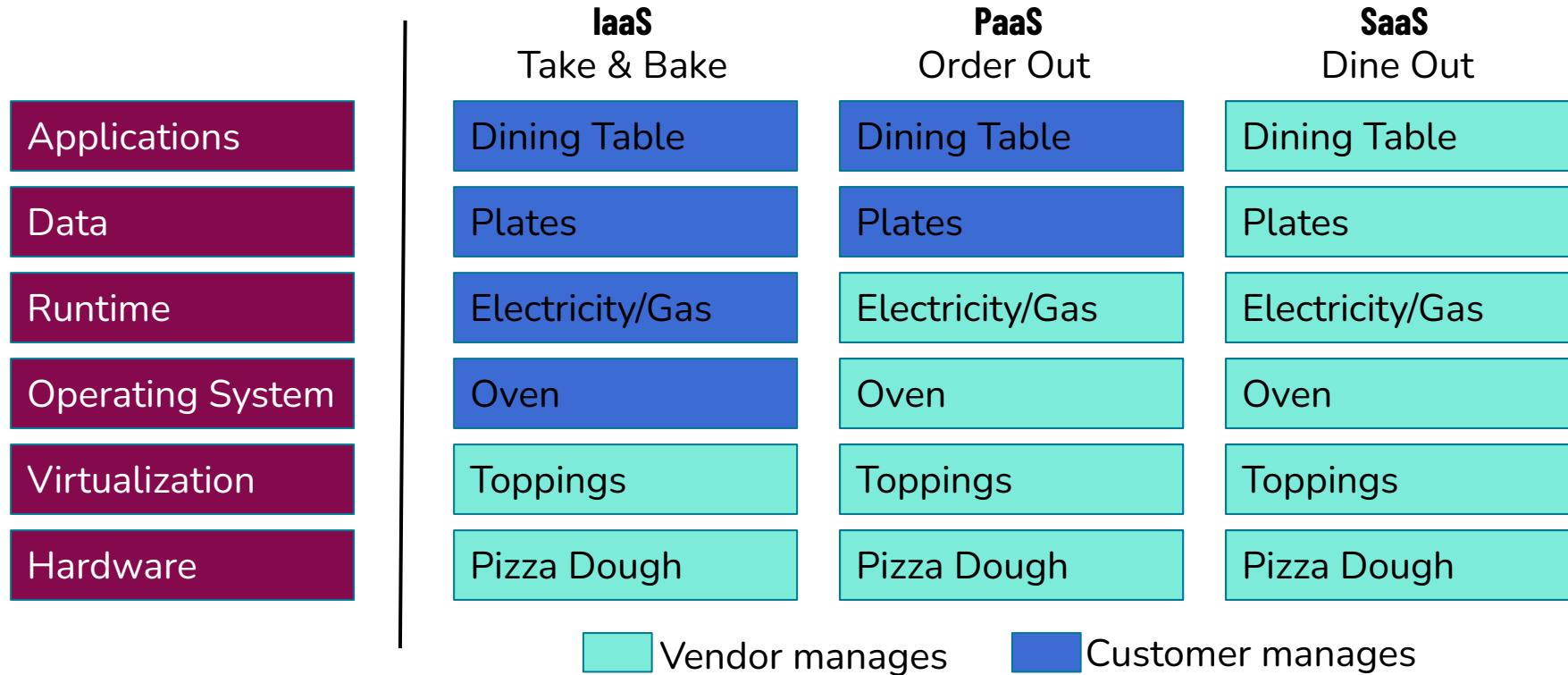
PaaS allows developers the freedom to concentrate on building software without having to worry about operating systems, software updates, storage, or infrastructure.

Examples include:

- AWS Elastic Beanstalk
- Google App Engine
- Heroku



# IT'S A SERVICE



# DEPLOYMENT MODELS | PUBLIC CLOUD

Public clouds are the most common way of deploying cloud computing.

All the hardware, software, and other supporting infrastructure is owned and managed by a cloud provider such as Microsoft Azure or AWS.

In a public cloud, **you share the same hardware, storage, and network devices with other organizations.**



# DEPLOYMENT MODELS | PRIVATE CLOUD

A private cloud consists of computing resources used exclusively by one business or organization.

In a private cloud, the services and infrastructure are maintained on a private network and **the hardware is dedicated solely to your organization.**

In this way, a private cloud can make it easier for an organization to customize its resources to meet specific IT requirements.



## Wrap-up

- What is the cloud?
- How does it work?
- What are the different service models?

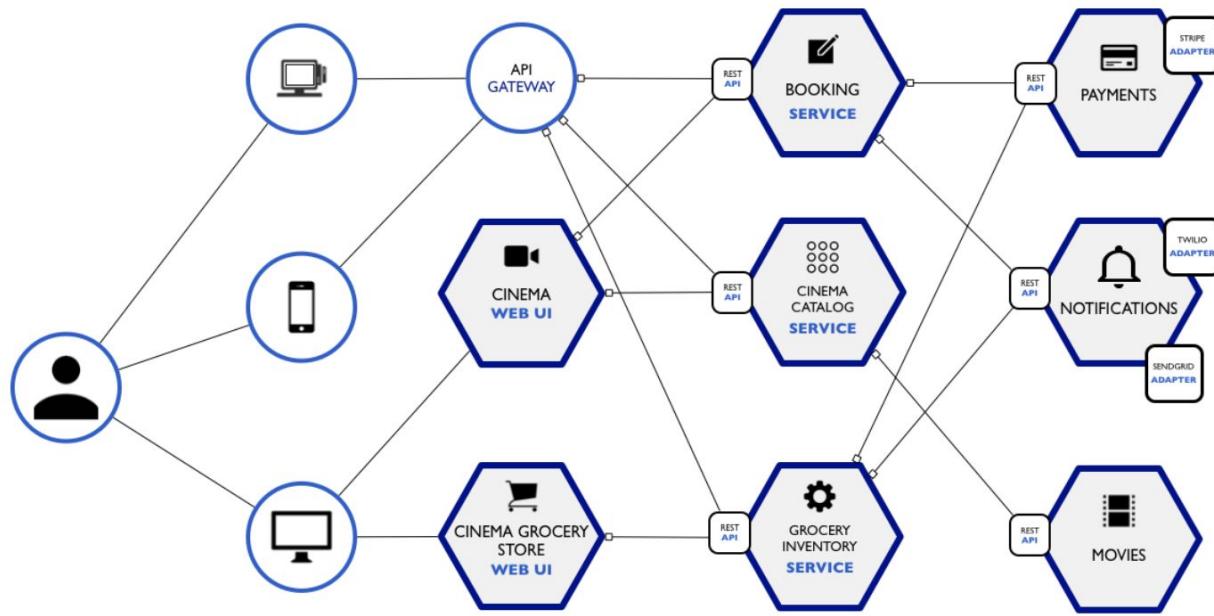
Come off  
mute or  
raise your  
hand to  
share your  
answers.

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# Microservices

# The Microservice Architecture



- Each service is **independently** deployable.
- Each service has its own logic and database with a **narrow goal**.
- Microservices are intended to manage a **single concern** or function.

# Microservice Architecture



## The Good

- Complexity is made visible
- Services can be separately upgraded and deployed
- Easier to scale development across teams
- Highly scalable infrastructure
- Discrete testing and QA
- Language Independence

## The Bad

- Cross-service data queries are slow
- Development environments are complex
- Debugging is more complex across services
- Standardization and clear ownership is MUCH harder
- Increased baseline infrastructure and environment costs

## Discussion - Eye on the DMV

Our Model DMV Application was split from a Monolith into:

- 3 backend services each with a separate database (driver, plate, license)
- 1 front end React application service
- 1 HTTP API layer service

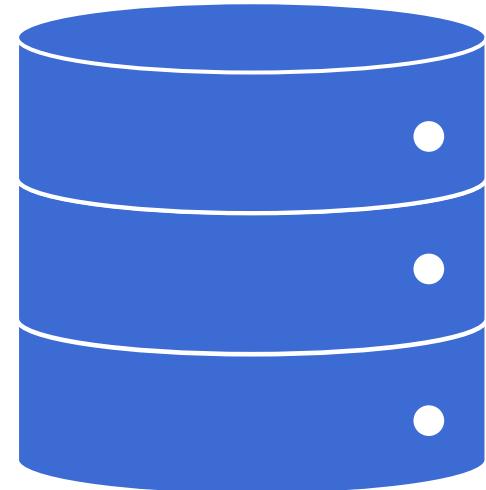
What are some advantages and disadvantages to this approach?



# Create a Separate Datastore for Each Microservice

Breaking apart the data can make data management more complicated because the separate storage systems can easily get out sync or become inconsistent, and foreign keys can change unexpectedly.

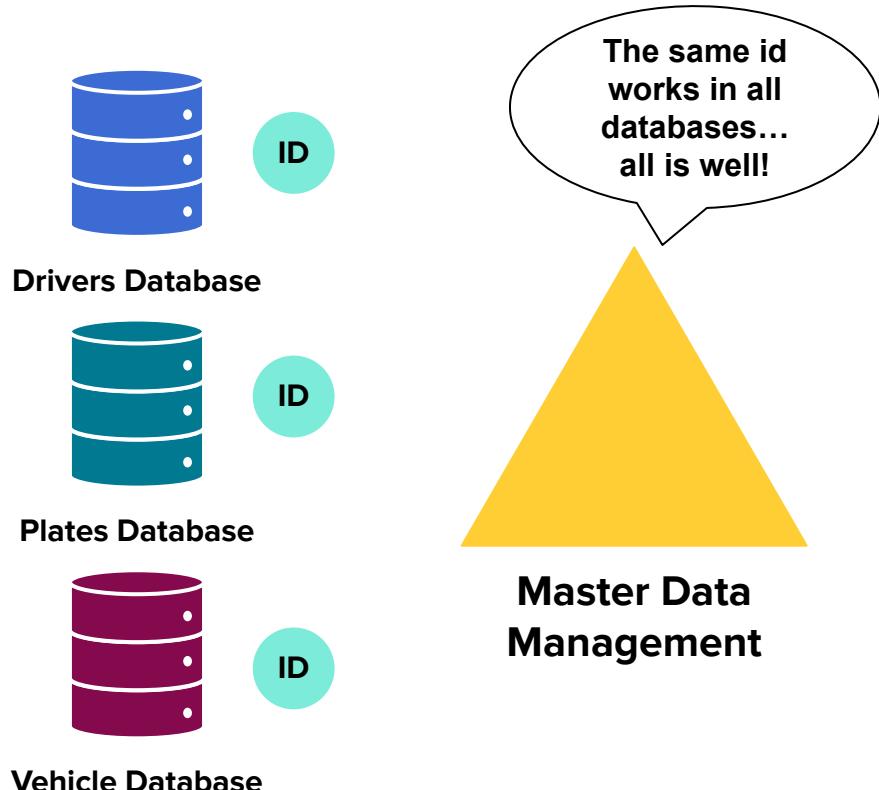
**You need to add a tool that performs master data management (MDM),** operating in the background to find and fix inconsistencies.



# Master Data Management Tools

**MDM tools** might examine every database that stores subscriber IDs to verify that the same IDs exist in all of them (there aren't missing or extra IDs in any one database). You can write your own tool or buy one.

Many commercial relational database management systems (RDBMSs) do these kinds of checks, but they usually impose **too many requirements for coupling**, and so don't scale.





# Splitting the Database

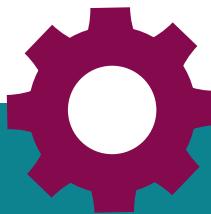
One of the biggest differences between classical service-oriented architecture and microservice architecture is that each microservice has a discrete data store. Consider one of the applications you have either built or worked on.

**Q: What are the advantages and challenges of splitting the database into discrete databases?**

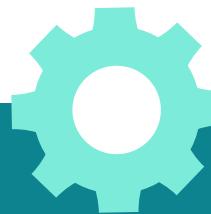


# Do a Separate Build for Each Microservice

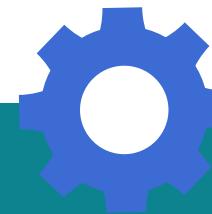
**Do a separate build for each microservice**, so that it can pull in component files from the repository at the revision levels appropriate to it.



Decommissioning old file versions becomes harder and must be very deliberate.



The asymmetry is intentional; you want introducing a new microservice, file, or function to be easy, not dangerous.



Microservices may pull in a similar set of files, but at different revision levels.

# Recap

- Introduction to various Architecture patterns
  - Service-Oriented Architecture
  - Monolith
  - Microservices
- Considering Databases for Microservices



Any Questions



# Break Time

# Up Next

- Security introductions
- Our Model Application DMV introduction/setup



Any Questions

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# Web Application Security



# Open Web Application Security Project | Top 10 Security Risks

- 1** | Broken Access Control
- 2** | Cryptographic Failure
- 3** | Injection
- 4** | Insecure Design
- 5** | Security Misconfiguration

- 6** | Using Components With Known Vulnerabilities
- 7** | Broken Authentication
- 8** | Software and Data Integrity Failures
- 9** | Insufficient Logging and Monitoring
- 10** | Server Side Request Forgery





### Group Exercise:

## Research a Security Risk

15 minutes



In small groups of 2-3, research one of the listed top 10 security risks and present to the rest of the class.

Describe what the problem is and, if possible, provide an example of how that problem might be introduced into an application and/or solved.



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**Security is part of the *architecture*  
not something added afterwards**

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# Encryption

# Encryption at Rest

This expansive category includes keeping all drives and files encrypted when not in use.

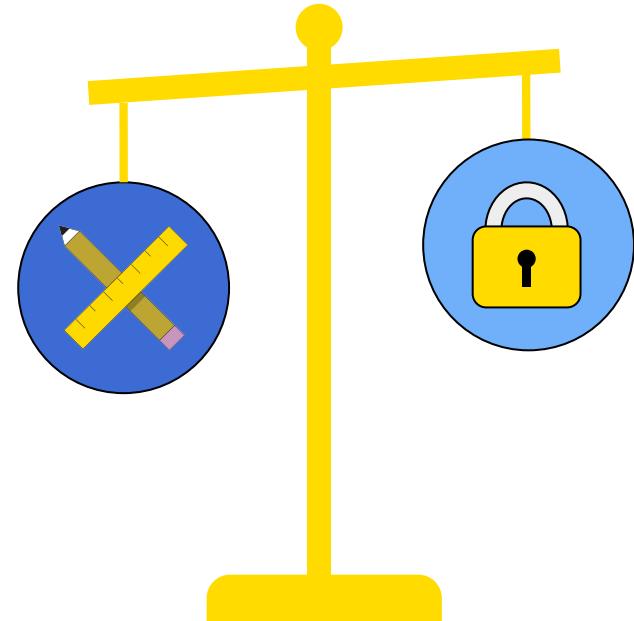


- BitLocker & FileVault 2 on laptops
- Encryption in cloud volumes
- Encrypted compressed files
- Encrypted backups

# Encrypting Data In Use

Keeping data encrypted while in use is an art of balancing security and utility.

- Field-level encryption in the database
- Keeping data encrypted in memory
- Encryption in search indexes



# JSON Web Tokens: Passable, Encrypted Data

In the context of our microservices, we'll be using the gold standard of modern authentication protocols: JSON Web Tokens.

JWTs allow our API to confirm requests coming in are authenticated in a way that won't compromise the data if the request is intercepted.



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# Authorization, Roles & Permissions



# Who's Allowed To Do What

We need to store information about **who** is allowed to do **what** in our database.

We also know that regardless of whether we end up with tens, hundreds, or thousands of users, we want to describe who can do what in a way that is expressive but not too complicated.



# A Little History

Historically, user authentication and authorization was handled by each individual application.

This means applications would need to:

- Track users and passwords.
- Contain a mechanism to match each user to the functions they were allowed to perform.
- Handle the security of the user/permissions framework.



# Let's look at a few permission types...

**Attribute-based  
Permissions**

**User-Level  
Permissions**

**Role-Based  
Permissions**

# User-Level Permissions

User permissions are based on attributes:

- User
- Item

What permissions does this user have?

Settings ▶ Advanced Settings

**Content Types**  
Specify whether to allow the management of content types on this list. Each content type will appear on the new button and can have a unique set of columns, workflows and other behaviors.

Allow management of content types?  
 Yes  No

**Item-level Permissions**  
Specify which items users can read and edit.

**Note:** Users with the Cancel Checkout permission can read and edit all items. Learn about managing permission settings.

**Read access:** Specify which items users are allowed to read

Read all items  
 Read items that were created by the user

**Create and Edit access:** Specify which items users are allowed to create and edit

Create and edit all items  
 Create items and edit items that were created by the user  
 None

**Attachments**  
Specify whether users can attach files to items in this list.

Attachments to list items are:

Enabled  
 Disabled

Image 6: User Permissions GUI

# Role-Based Permissions

Commonly referred to as  
“role-based access control”  
(RBAC).

**What benefit does RBAC offer?**

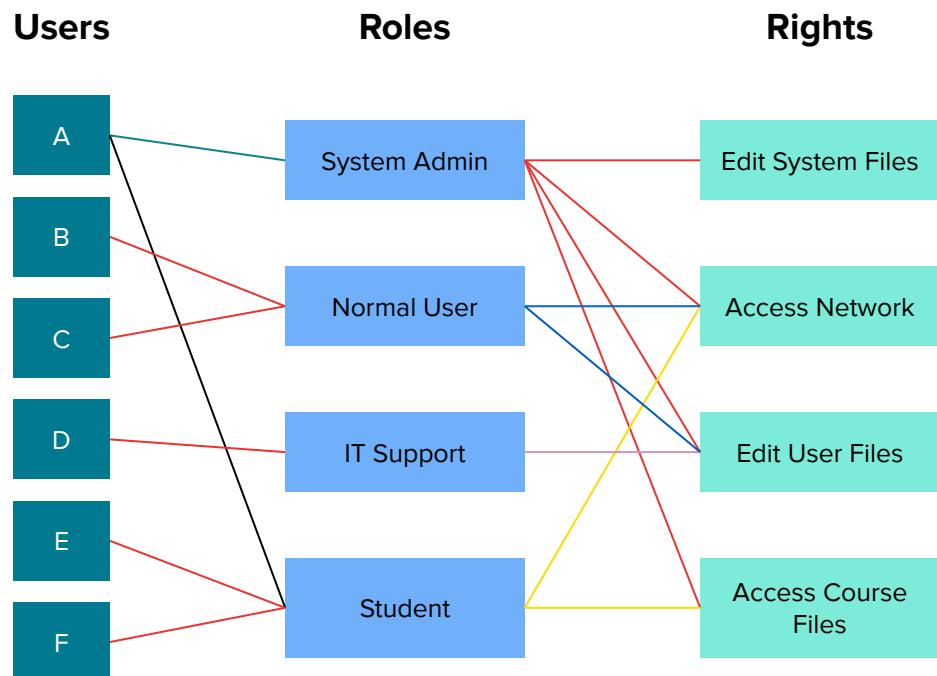


Image 7: Role-Based Permissions Diagram

# Attribute-Based Permissions

Attribute based controls are computationally expensive but **VERY** fine-grained.

A classic example is users being able to edit or delete their own posts on social media, but not those of other users.

**What benefit does ABAC offer?**

## Attribute-Based Access Control

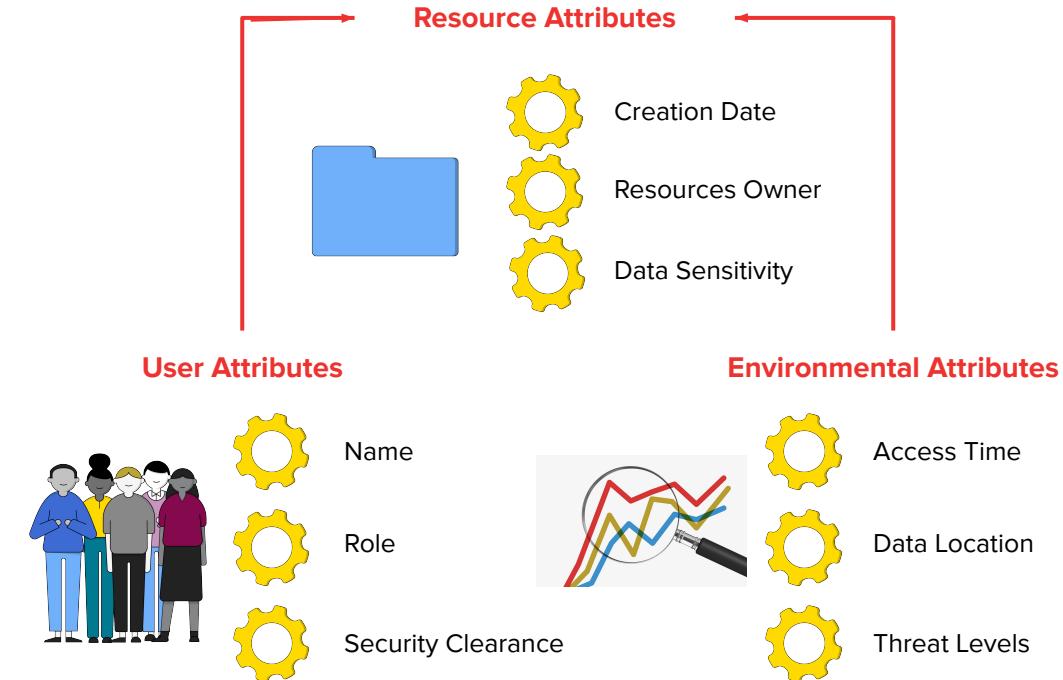


Image 8: Attribute-Based Access Control Flow Chart



## Group Exercise:

15 minutes



# Authorization, Roles, Permissions

In breakout room groups, discuss which authorizations, roles, and permissions you would apply to the app assigned to your group. We'll come back and compare answers together.

### E-commerce Platform:

You are developing an e-commerce platform where users can browse products, add items to their cart, and make purchases. What are the essential roles and permissions needed to ensure secure transactions, protect user data, and manage the overall system?

### Financial Management App:

If you're building a financial management application to help users track their expenses and budgets, how would you implement roles and permissions to safeguard sensitive financial data and allow users to collaborate securely with family members or financial advisors?

### Travel Booking Platform:

You're creating an online travel booking platform where users can search for flights, hotels, and rental cars. What role-based access controls would you employ to safeguard personal payment information and ensure that only legitimate booking modifications are made?

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# Configuration & Secrets



# Configuration Management



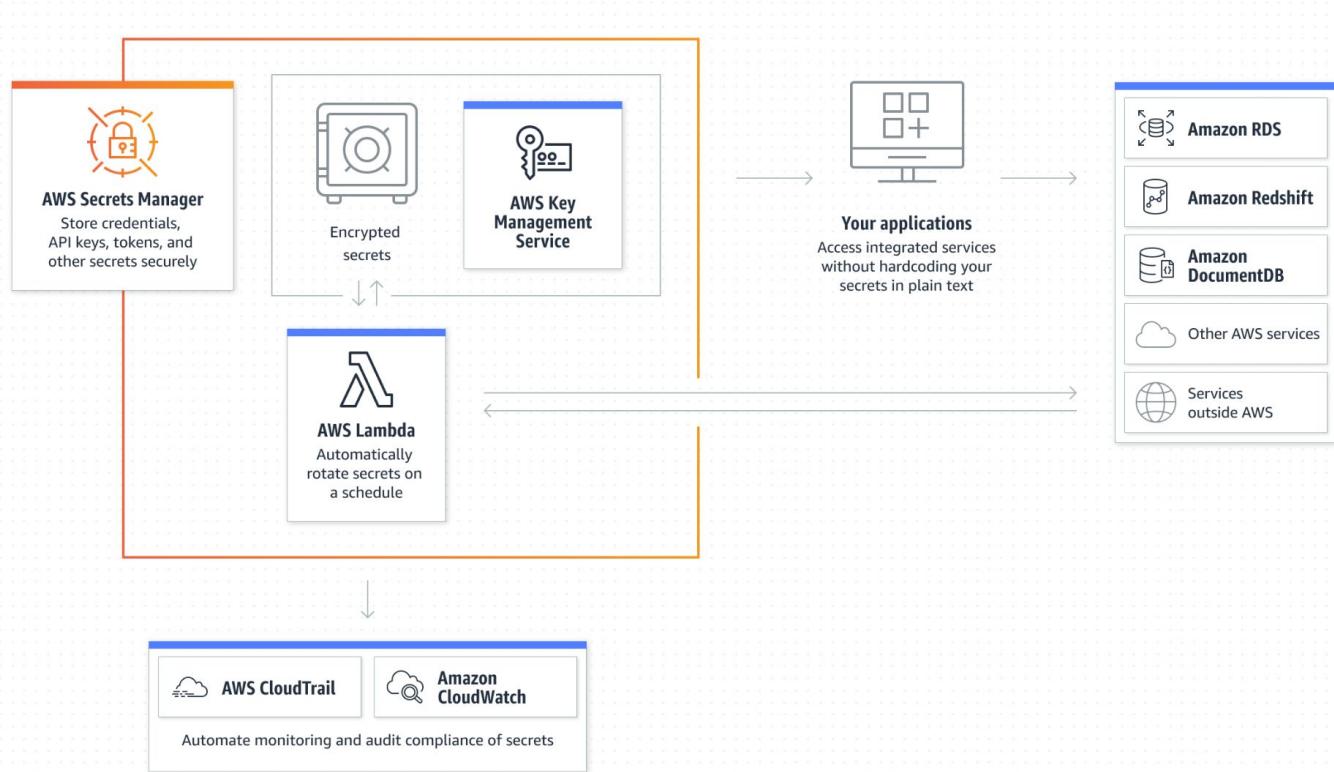
## DO

- Separate sensitive and non-sensitive values
- Choose a way to retrieve secret values
- Plan how to deploy in different environments
- Plan how to disseminate configurations to different team members and environments

## DON'T

- Store sensitive values in git. **EVER!**
- Skip configuration planning to ‘just get building’
- Choose a method that doesn’t scale well across a cloud environment

# Secrets Managers



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# The Model Application

# Vehicle Manager

The **Vehicle Manager model** application is a miniature of a system to manage vehicles, drivers, and license plates.

Think of this as a small scale Department of Motor Vehicles (DMV).

## Listing of drivers

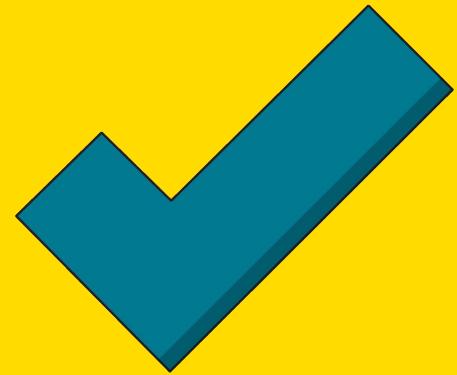
Previous Next

Name	Email	State	
Aaron Bobby	baarongz@washington.edu	Virginia	<button>Delete</button>
Abbadio Brnaby	babbadom5@blogs.com	Virginia	<button>Delete</button>
Aberchirder Norrie	naberchirdr0@multiply.com	Virginia	<button>Delete</button>
Absalom Tawsha	tabsalom3t@nsw.gov.au	Virginia	<button>Delete</button>
Achromov Lenee	lachromovjy@merriam-webster.com	Virginia	<button>Delete</button>
Adamsky Vivianna	vadamskyau@angelfire.com	Virginia	<button>Delete</button>
Adger Odette	oadgerc2@linkedin.com	Virginia	<button>Delete</button>
Ahlin Morton	mahlina0@europa.eu	Virginia	<button>Delete</button>
Albertson Marlene	malbertson4y@google.com	Virginia	<button>Delete</button>
Alcido Natale	nalcido2w@moonfruit.com	Virginia	<button>Delete</button>
Alf Athene	aalfhz@pbs.org	Virginia	<button>Delete</button>
Algate Moll	malgatedo@merriam-webster.com	Virginia	<button>Delete</button>
Allbones Edgar	eallbones7s@bloglovin.com	Virginia	<button>Delete</button>
Altamirano Sigismondo	saltamirano4z@myspace.com	Virginia	<button>Delete</button>
Amorts Renell	ramortsrga@nationalgeographic.com	Virginia	<button>Delete</button>
Andres Lynnea	landresmr@weebly.com	Virginia	<button>Delete</button>

Image 10: Vehicle Managers Example GUI

# In This Model Application...

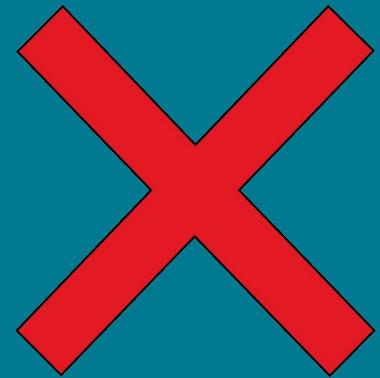
- Microservice-based architecture  
w/3 fully independent services
- Rest interfaces
- Asynchronous patterns
- Saga-pattern data updates
- Independent stores
- Configuration management
- React UI



# Not In The Application

(for reasons of time & sanity)

- Authentication & Authorization
- Secrets Management
- Step Functions & Orchestration
- GraphQL



# Application Architecture: What We Are Simulating

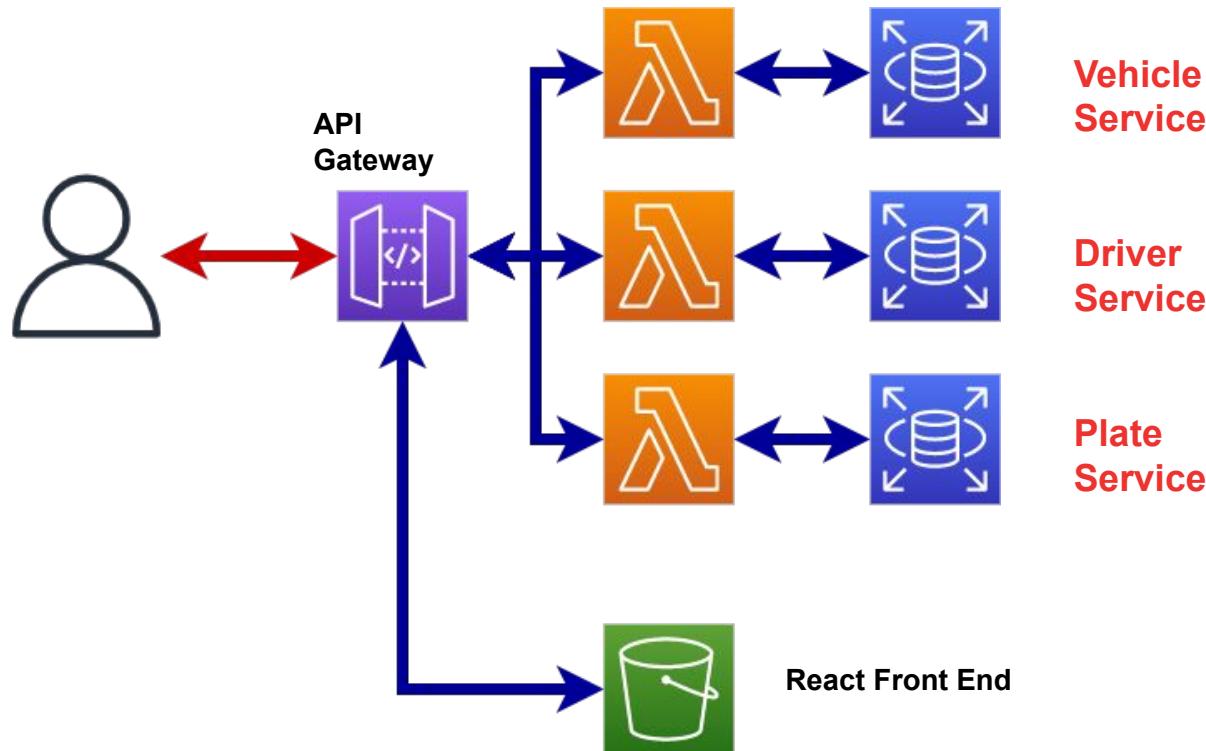
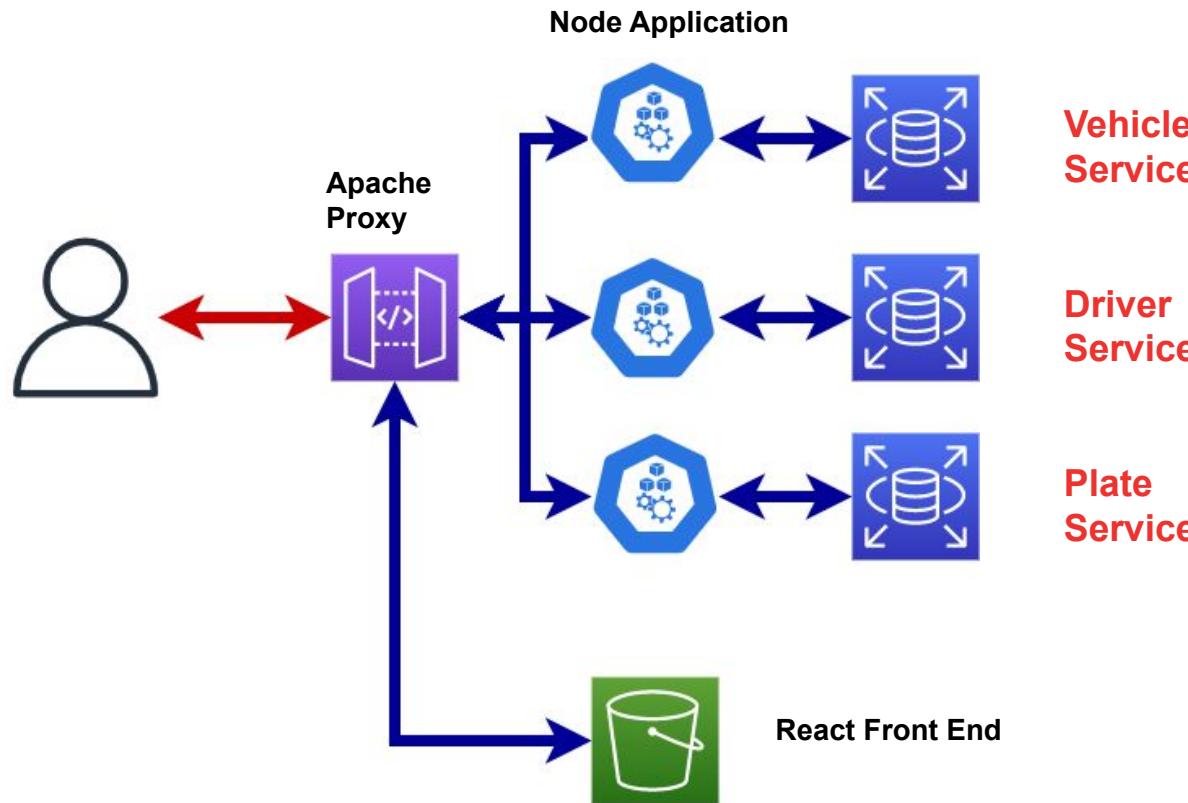


Image 11: Application Architecture Flow Chart

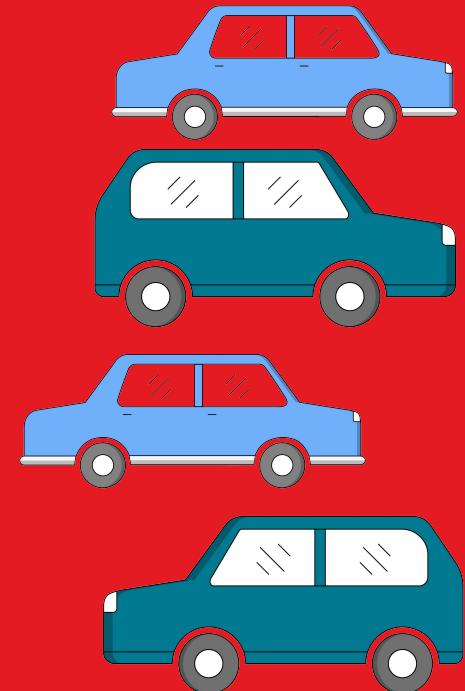
# Application Architecture: Build



# Application's User Stories

**“I am a corporate vehicle fleet manager,  
and I want to...”**

- See what vehicles a driver has
- View a Driver's information
- Add a driver
- Update a driver
- Delete a driver (and all associated plates)
- Add a plate to a driver



# API Gateways

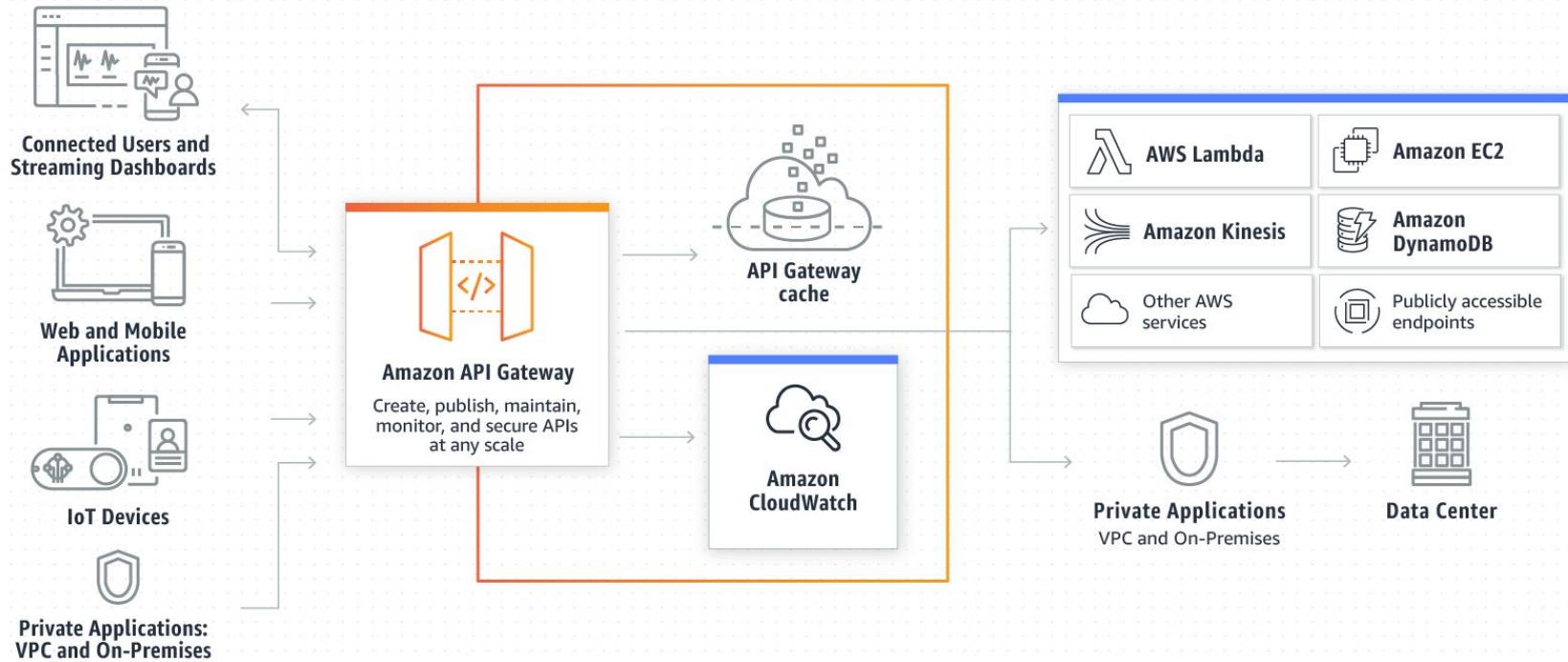
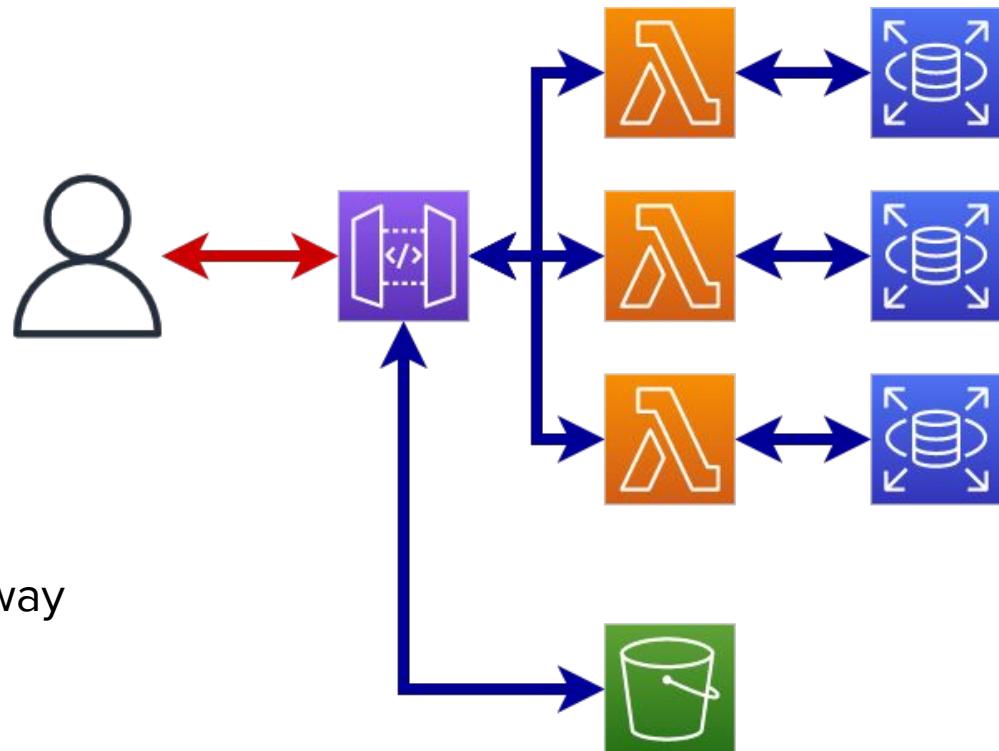


Image 13: API Gateways Flow Chart

# Apache As A Gateway



We're using apache as a stand-in for the AWS Gateway on our local machine.

Image 14: Apache As A Gateway Flow Chart

# Recap

- Security
  - Access
  - Encryption
- Model Application introduction
  - Setup
  - Backend services
  - Frontend
  - High level architecture



Any Questions

# Up Next

- Node & NPM
- Asynchronous considerations



Any Questions

# Node & NPM

- **node.js** is a JavaScript runtime that runs on the server side.
- It is built on Chrome's V8 JavaScript engine.
- node.js comes with npm (**Node Package Manager**) which is used to manage packages and dependencies.
- **npm** is the largest package manager for JavaScript and contains hundreds of thousands of packages.
- With npm, developers can easily install, update, and manage packages for their projects.
- npm is a crucial tool for any Node.js developer.

# Review: Asynchronous Programming

- Asynchronous programming is a programming paradigm where the program can continue to run without waiting for blocking operations to finish.
- In JavaScript, asynchronous programming is commonly implemented using callbacks, promises, and `async/await`.
- `Async/await` is a more recent addition to JavaScript and provides a way to write asynchronous code that looks and behaves like synchronous code.
- `Async/await` is built on top of promises and makes working with asynchronous operations easier and more intuitive.
- The `async` keyword is used before a function declaration to indicate that it returns a promise.
- The `await` keyword is used before an asynchronous operation and causes the code to pause until the operation is complete.
- `Async/await` provides a more concise and readable way to write asynchronous code compared to callbacks and promises.



# Review: Asynchronous Programming (Continued)

```
async function fetchData() {  
  try {  
    const response = await fetch("https://api.example.com/data");  
    const data = await response.json();  
    console.log(data);  
  } catch (error) {  
    console.error(error);  
  }  
}  
  
fetchData();
```

Image 15: Asynchronous Programming Code Example

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# Setting Up Our Environment

**Goal:**

To see how the completed app should function.

We'll be setting up our own development space tomorrow.

**Instructions:**

1. Git + SSH Set-up
2. Clone the repository
3. Install Apache & MySQL
4. Set up the Apache gateway
  - o Virtualhost
  - o Hosts file
5. Download NPM packages
6. Set up configuration files
7. Build the sample react app
8. Start each service





Guided Walk-Through:

## Step 1 - Git and SSH Set-up

[Follow the instructions in this Git SSH README Guide to get started.](#)

# Recap

- Asynchronous concerns
- Environment setup



Any Questions



# Break Time

# Up Next

- Designing APIs
- Experimenting in Model Application's postman collection



Any Questions



Guided Walk-Through:

## Step 2 - DMV Microservices Application

[Follow the instructions in this Git README Guide to get started.](#)





## Guided Walk-Through:

# Step 1 - Git and SSH Set-up

Follow the instructions in this Git SSH README Guide to get started.



## Day 1 Git SSH Guide

### Connecting workspace to GIT using SSH

**NOTE:** if you haven't set up your Github SSH key yet in your workspace, follow the guides provided by github for generating an SSH key, adding it to your SSH agent, and then adding that key to your GA github account. Use the following two resources,[Creating an ssh key on linux](#) and [Adding your SSH key to github using the browser](#)

We'll first need to create an SSH key on our workspaces.

Open a new terminal in your workspace and execute the following commands.

1. Let's create a new SSH key using `keygen` terminal tool.

**NOTE:** be sure to change the email with the email associated with your GA github enterprise account.





## Guided Walk-Through:

# Step 2 - Clone the repository

1. Goto this Model Application link in your browser (*good idea to bookmark this*):  
<http://bit.ly/3QixRF8>
2. In your VM, open your Terminal and cd into your Documents folder: **cd ~/Documents**
3. Run this command: **git clone**  
<git@git.generalassemb.ly:ModernEngineering/ModelApplication-cohort4-oct2023.git>
4. **cd ModelApplication-cohort4-oct2023/** into the app folder.
5. Open in VS Code: **code .**

The screenshot shows a GitHub repository page for 'ModernEngineering / ModelApplication-cohort4-oct2023'. The repository is private. The main navigation bar includes Code, Issues, Pull requests, Projects, Wiki, Security, Insights, and Settings. Below the navigation bar, there's a summary showing 'main' branch, 1 branch, 0 tags, and a green 'Code' button. The commit history table lists the following commits:

Author	Commit Message	Date
marcwright-rem	rename title	a727af7 25 seconds ago
	replace sample.env	7 months ago
	.gitignore	initial commit WIP
	01-git-ssh-setup.md	cleaned up repo and copied day01 lecture notes here
	02-setup-script-info.md	rename title
	03-setup-run-ui-backend.md	cleaned up repo and copied day01 lecture notes here
	README.md	Update README.md
	install.sh	initial commit WIP
	modelapp-setup.sh	cleaned up repo and copied day01 lecture notes here
	runfiles.sh	clean up runfiles.sh script





## Guided Walk-Through:

# Steps 3 and 4 - Install and Configure Apache and MySQL

Follow the instructions in this [02-setup-script-info.md](#) file to set up the Model Application



## Model Application set up guide

**NOTE:** These steps are all captured in the `modelapp-setup.sh` script. You can perform all of these steps by running the following command inside of the `D1-setup-distributed-systems` directory.

```
sudo bash ./modelapp-setup.sh
```

The `modelapp-setup.sh` script will do the following (If the script fails you can manually install using the steps below).

1. Install nodemon: a node monitoring tool we'll be using when running our backend services locally.
2. Install MariaDB: A version of MySql maintained by RedHat and easy to install on centos.
3. Run simple database setup script: We'll create a non root db user and our three databases and grant the proper permissions to those databases to our db user.
4. Install Apache: We'll install the httpd package, which is a clean install of apache through Yum.
5. Configure hosts and proxy for apache: We'll just move our preconfigured hosts and 000-default.conf files to their proper locations in /etc directory and restart apache.





## Guided Walk-Through:

# Step 5 - Install NPM Packages

main ▾ [ModelApplication-cohort4-oct2023 / install.sh](#)

 marcicloud11 update install.sh

1 contributor

8 lines (8 sloc) | 123 Bytes

```
1 cd ./solution_code/uiSrc
2 npm install
3 cd ../servicesSrc/driver
4 npm install
5 cd ../plate
6 npm install
7 cd ../vehicle
8 npm install
```

1. We'll run the ***install.sh*** file found [here](#). You should already have the file locally. Make sure that you're in the **ModelApplication-cohort4-oct2023** directory and run ***bash install.sh***

2. To test in the browser, go to:  
[\*\*\*http://localhost:80\*\*\*](http://localhost:80)

You should see “Service Unavailable” since we haven’t started our servers yet.

### Service Unavailable

The server is temporarily unable to service your request due to maintenance downtime or capacity problems. Please try again later.





## Guided Walk-Through:

# Start your server engines

1. In ***solution\_code/uiSrc***, rename ***sample.env*** to ***.env***
2. We'll run the ***runfile.sh*** file found [here](#).  
You should already have this file locally.  
From the Model Application root  
directory run: ***bash runfiles.sh***
3. Use this [README for reference](#)
4. To test in the browser, go to:  
***http://dmv.Localdev***

Name	Email	State	
Aaron Bobby	baarongz@washington.edu	Virginia	<button>Delete</button>
Abbado Brnaby	babbadom5@blogs.com	Virginia	<button>Delete</button>
Aberchirder Norrie	naberchirderr0@multiply.com	Virginia	<button>Delete</button>
Absalom Tawsha	tabsalom3@nsw.gov.au	Virginia	<button>Delete</button>
Achromov Lenee	lachromovjy@merriam-webster.com	Virginia	<button>Delete</button>

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# Code Exploration





## Guided Walk-Through:

# Explore the DMV Code

The 03-setup-run-ui-backend.md file has detail on the app structure

A screenshot of a Mozilla Firefox browser window titled "React App - Mozilla Firefox". The address bar shows "dmv.localdev". The main content area displays a "GA DMV" application. A navigation bar at the top has "DRIVERS" selected. Below it, a heading says "Listing of drivers" with "Previous" and "Next" buttons. A table lists five drivers with columns for Name, Email, State, and a "Delete" button.

Name	Email	State	
Aaron Bobby	baarongz@washington.edu	Virginia	<button>Delete</button>
Abbado Brnaby	babbadom5@blogs.com	Virginia	<button>Delete</button>
Aberchirder Norrie	naberchirderr0@multiply.com	Virginia	<button>Delete</button>
Absalom Tawsha	tabsalom3t@nsw.gov.au	Virginia	<button>Delete</button>
Achromov Lenee	lachromovjy@merriam-webster.com	Virginia	<button>Delete</button>



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# Designing our API

# Considerations

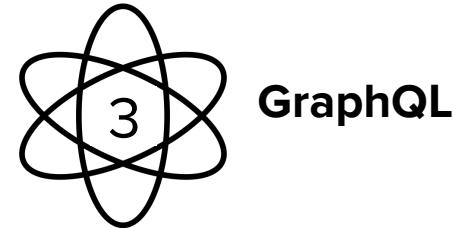
- What workflows do we need to support?
- What are the resource limits?
  - Is bandwidth limited?
  - Is back-end capacity limited?
  - Is the data complex?

## API Convention Options

< 1 >    **XML**



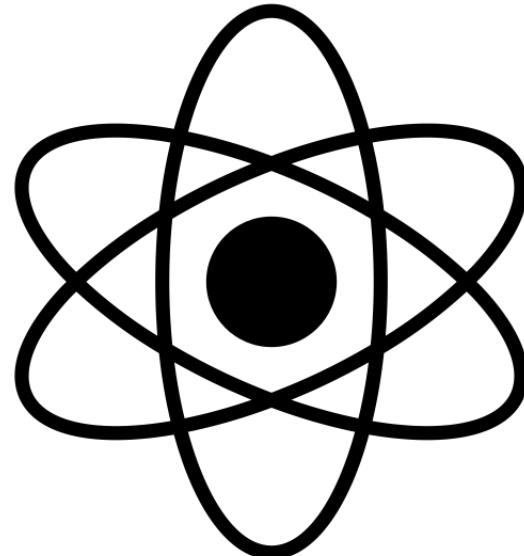
**REST**



**GraphQL**

# What is GraphQL?

- **GraphQL** is an open-source query language for **APIs**.
- It's functionally an alternative to traditional **REST** approaches



# REST vs. GraphQL

## REST APIs

- Return all the fields from the API every time
- Require different endpoints for each service
- Require multiple requests to combine different data sources

## GraphQL APIs

- Request only the fields needed
- Aggregate data from multiple sources
- Move the multi-source query logic to the server



# Example of GraphQL API Interactions

## POST Request

```
{  
  orders {  
    id  
    productsList {  
      product {  
        name  
        price  
      }  
      quantity  
    }  
    totalAmount  
  }  
}
```

Image 16: GraphQL API Post Request Interaction

## Response

```
{  
  "data": {  
    "orders": [  
      {  
        "id": 1,  
        "productsList": [  
          {  
            "product": {  
              "name": "orange",  
              "price": 1.5  
            },  
            "quantity": 100  
          }],  
          "totalAmount": 150  
        }  
      }  
    ]  
  }  
}
```

Image 17: GraphQL API Response Interaction

# Example of REST API Interactions

## POST Request

```
{  
    "vin": "JH4NA21683T088489",  
    "Make_Id": "8359",  
    "Model_Id": 139,  
    "plateText": "TYUC0RP",  
    "driver_id": 86  
}
```

Image 18: REST API Post Request Interaction

## Response

```
{  
    "Status": "SUCCESS",  
    "Message": "Response successful",  
    "RecordUpdated": 5  
}
```

Image 19: REST API Post Response Interaction





Solo Exercise:

## Daily Exit Ticket

3 minutes



- Please take a moment to give us your feedback after today's course!
- Use the QR code or follow the link: <https://bit.ly/pruMEF-c3>



bitly

Scan Me!

